1. Introduction

Climate change due to greenhouse warming is expected to have major impacts on the global environment and human activities. To assess its likely impacts an international group of experts, the Intergovernmental Panel on Climate Change (IPCC) has been created. The latest update of the their report *Climate Change 1995* (1996) includes a chapter (Chapter 7 of Working Group II) on climate change and its impacts on the polar regions. The report lists the degree of confidence in the following predictions, following a doubling of atmospheric CO_2:

- Many components of the cryosphere (snow and ice regions of Earth) are sensitive to changes in atmospheric temperature because of their thermal proximity to melting. The extent of glaciers has often been used as an indicator of past global temperatures (High Confidence).
- Projected warming of the climate will reduce the area and volume of the cryosphere. This reduction will have significant impacts on related ecosystems, associated people, and their livelihoods (High Confidence).
- There will be striking changes in the landscapes of many high mountain ranges and of lands at northern high latitudes (High Confidence). These changes may be exacerbated where they are accompanied by growing numbers of people and increased economic activities (Medium Confidence).

The chapter goes on to state that the following changes and associated impacts on the polar regions are likely:

- Pronounced reductions in seasonal snow, permafrost, glacial and periglacial features with a corresponding shift in landscape processes (High Confidence).
- Increases in the thickness of the active layer of permafrost and the disappearance of most of the ice-rich discontinuous permafrost over a century-long time span (High Confidence).
- Disappearance of up to a quarter of the presently existing mountain glacier mass (Medium Confidence).
- Less ice on rivers and lakes. Freeze-up dates will be delayed, and break-up will begin earlier. The river-ice season could be shortened by up to a month (Medium Confidence).
- A large change in the extent and thickness of sea ice, not only from warming but also from changes in circulation patterns of both atmosphere and oceans. There is likely to be substantially less sea ice in the polar oceans (Medium Confidence).

As a further result of these changes in the cryosphere, the following additional impacts are expected:

- Widespread loss of discontinuous permafrost will trigger erosion or subsidence of ice-rich landscapes, change hydrologic processes, and release carbon dioxide (CO_2) and methane (CH_4) to the atmosphere (High Confidence).

- Cryospheric change will reduce slope stability and increase the incidence of natural hazards for people, structures, and communication links. Buildings, other structures, pipelines, and communication links will be threatened (High Confidence).
- Engineering and agricultural practices will need to adjust to changes in snow, ice, and permafrost distributions (High Confidence).
- Thawing of permafrost could lead to disruption of petroleum production and distribution systems in the tundra, unless mitigation techniques are adopted. Reduced sea ice may aid new exploration and production of oil in the Arctic Basin (High Confidence).
- Improved opportunities for water transport, tourism and trade are expected from a reduction in sea, river, and lake ice. These will have important implications for the people and economies of the Arctic (Medium Confidence).

Additional impacts occur on arctic biota and ecosystems, but these are not discussed in detail in the IPCC report. It is very likely, however, that reductions in snow and ice covers will adversely affect species which depend on these features for habitat, feeding, and reproduction. Snow cover changes on land affect both plants and animals, including large mammals such as moose, caribou, and muskoxen. The marine ecosystem, including ice algal communities, polar cod, ringed seals, walrus, and polar bears will be affected by changes in sea ice extent and characteristics.

These predictions apply in a very general sense to the high latitudes and are not region-specific. It is known, on the other hand, that the climate worldwide, including the Arctic, has changed in a very patchy manner, with warming occurring in most areas but cooling being present in some other smaller regions. This has led the U.S. Global Change Research Program, and indeed other nations' global change research, to adopt a regional approach to assessing the consequences of changes in climate and other global environmental conditions.

To examine the validity of the predictions above, a workshop on regional impacts of global change in Alaska and the Bering Sea region, defined roughly as the area between the Mackenzie River in Canada and the Lena River in Siberia, was held at the University of Alaska Fairbanks on 3-6 June 1997. The resulting proceedings represent the integration of information provided to the workshop participants in the form of technical background papers (prepared in advance by guest authors) along with the additional insights and information gained as a result of the workshop group discussions among scientists and stakeholders during the course of the workshop. The following chapters summarize current thinking about the consequences of climate change in nine critical sectors: forests, tundra, wildlife and reindeer, land use, marine biological resources, subsistence fisheries, coastal systems, permafrost, and non-renewable resources.

A key conclusion is that changes in historical climate patterns in the region over the last three decades have been substantial, of the magnitude expected from greenhouse warming. The resulting impacts observed are large and can only get even more pronounced if present climate trends continue.